In the claims:

1. A method for gamut mapping of an input image using a space varying algorithm, comprising:

receiving the input image;

converting color representations of an image pixel set to produce a corresponding electrical values set;

applying the space varying algorithm to the electrical values set to produce a color-mapped value set; and

reconverting the color-mapped value set to an output image.

2. The method of claim 1, wherein the space varying algorithm minimizes a variational problem represented by:

$E(u) = \int_{\Omega} \left(D^2 + \alpha |\nabla D|^2\right) d\Omega$, subject to $u \in \vartheta$, wherein $\Omega$ is a support of the input image, $\alpha$ is a non-negative real number, $D=g*(u-u_o)$, g is a normalized Gaussian kernel with zero mean and a small variance $\sigma$, $u_o$ is the input image, and u is the output image.

3. The method of claim 2, further comprising:

solving the variational problem at a high value of $\alpha$;

solving the variational problem at a low value of $\alpha$; and

averaging the solutions.

4. The method of claim 3, wherein the step of averaging the solutions comprises using a spatially adaptive weighting scheme, comprising:

$$u_{final}[k,j] = w[k,j]u_{small}[k,j](1 - w[k,j])u_{high}[k,j],$$

wherein the weight $w[k,j]$, comprises:

$$w[k,j] = \frac{1}{1+\beta|\nabla g * u_0|^2}, \text{ and}$$

wherein $\beta$ is a non-negative real number.

5. The method of claim 2, wherein the variational problem is solved according to:

$$\frac{du}{dt} = \alpha g * \Delta D - g * D, \text{ subject to } u \in \vartheta.$$

6. The method of claim 2, wherein the space varying algorithm is solved according to:

$$u_{ij}^{n+1} = u_{ij}^{n} + \tau\left(\alpha L_{ij}^{n} - \overline{D_{ij}^{n}}\right),$$ subject to $u_{ij}^{n} \in \vartheta$, wherein

$$\tau = dt,$$
$$\overline{D^n} = g * g * \left(u^n - u_0\right)$$
$$L^n = D_2 * \left(u^n - u_0\right) \text{ and}$$
$$D_2 = g_x * g_x + g_y * g_y$$

7. The method of claim 1, wherein the space varying algorithm minimizes a variational problem represented by:

$$E(u) = \int_{\Omega} \left(\rho_1(D) + \alpha\rho_2(|\nabla D|)\right) d\Omega,$$ subject to $u \in \vartheta$, wherein $\rho_1$ and $\rho_2$ are scalar functions.

8. The method of claim 2, further comprising:

decimating the input image to create one or more resolution layers, wherein the one or more resolution layers comprises an image pyramid; and

solving the variational problem for each of the one or more resolution layers.

9. The method of claim 1, wherein the method is executed in a camera.

10. The method of claim 1, wherein the method is executed in a printer.

11. A method for color gamut mapping, comprising:

converting first colorimetric values of an input image to second colorimetric values of an output device, wherein output values are constrained within a gamut of the output device; and

using a space varying algorithm that solves an image difference problem.

12. A computer-readable memory for color gamut mapping, comprising an instruction set for executing color gamut mapping steps, the steps, comprising:

converting first colorimetric values of an original image to second colorimetric values, wherein output values are constrained within a gamut of the output device;using a space varying algorithm that solves an image difference problem; and

optimizing a solution to the image difference problem.

13. The computer-readable memory of claim 12, wherein the image difference problem is represented by:

$$E(u) = \int_{\Omega} \left(D^2 + \alpha|\nabla D|^2\right) d\Omega$$

subject to $u \in \vartheta$, wherein $\Omega$ is a support of an input image, $\alpha$ is a non-negative real number, $D=g*(u-u_0)$, g is a normalized Gaussian kernel with zero mean and small variance $\sigma$, $u_0$ is the input image, and u is an output image.

14. The computer-readable memory of claim 12, wherein the instruction set further comprises steps for:

solving the image difference problem at a high value of $\alpha$;

solving the image difference problem at a low value of $\alpha$; and

averaging the solutions.

15. The computer-readable memory of claim 14, wherein averaging the solutions comprises using a spatially adaptive weighting scheme, comprising:

$$u_{final}[k,j] = w[k,j]u_{small}[k,j](1-w[k,j])u_{high}[k,j], \text{ and}$$

wherein the weight $w[k, j]$, comprises:

$$w[k,j] = \frac{1}{1+\beta|\nabla g * u_0|^2}, \text{ and}$$

wherein $\beta$ is a non-negative real number.

16. The computer-readable memory of claim 12, wherein the image difference problem is represented by:

$$E(u) = \int_{\Omega} (\rho_1(D) + \alpha\rho_2(|\nabla D|))d\Omega, \text{ wherein } \rho_1 \text{ and } \rho_2 \text{ are scalar functions.}$$

17. The computer-readable memory of claim 12, wherein the instruction set further comprises steps for:

decimating the input image to create one or more resolution layers, wherein the one or more resolution layers comprise an image pyramid; and

solving the image difference problem for each of the one or more resolution layers.

18. The computer-readable memory of claim 17, wherein the instruction set further comprises steps for:

(a) initializing a first resolution layer;

(b) calculating a gradient G for the resolution layer, the gradient G comprising:

$G = \Delta(u - u_o) + \alpha_K(u - u_o)$, wherein $\Delta x$ is a convolution of each color plane of x with $K_{LAP} = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -2 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ and $\alpha_k = \alpha_o * 2^{2(k-1)}$;

(c) calculating a normalized steepest descent value $L_J = L_{J-1} - \mu_o * \mu_{NSD} * G$, wherein $\mu_o$ is a constant;

(d) projecting the value onto constraints $Proj_\vartheta(L_J)$, wherein $Proj_\vartheta(x)$is a projection of x into a gamut $\vartheta$; and

(e) for a subsequent resolution layer, repeating steps (b) – (d).

19. A method for image enhancement using gamut mapping, comprising:

receiving a input image;

from the input image, constructing an image pyramid having a plurality of resolution layers;

processing each resolution layer, wherein the processing includes completing a gradient iteration, by:

calculating a gradient G;

completing a gradient descent iteration; and

projecting the completed gradient descent iteration onto contstraints; and

computing an output image using the processed resolution layers.

20. The method of claim 19, wherein the gradient G, comprises:

$$G = \Delta(u - u_o) + \alpha_k(u - u_o),$$

wherein u is the output image, $u_o$ is the input image, and $\alpha$ is a non-negative real number.

21. The method of claim 19, wherein completing the gradient descent iteration comprises calculating:

$$\mu_{NSD} = \Sigma G^2 \Big/ \left(\Sigma(G * \Delta G) + \alpha_k \Sigma G^2\right)$$ ; and

$$L_j = L_{j-1} - \mu_o \cdot \mu_{NSD} \cdot G,$$

wherein $\mu_{NSD}$ is a normalized steepest descent parameter, $\mu_o$ is a constant, k is a number of resolution layers in the image pyramid, and j is a specific resolution layer.

22. The method of claim 19, wherein projecting the completed gradient descent iteration onto the constraints is given by:

$$L_J = Proj_{\vartheta}(L_J),$$

wherein $Proj_{\vartheta}(x)$ is a projection of x into a gamut $\vartheta$.

23. The method of claim 19, wherein constructing the image pyramid, comprises:

smoothing the input image with a Gaussian kernel;

decimating the input image; and

setting initial conductive $L_o = \max\{Sp\}$, wherein Sp is an image with the coarsest resolution layer for the image pyramid.

24. The method of claim 23, wherein the Gaussian kernel, comprises:

$$K_{PYR} = \begin{bmatrix} \frac{1}{16} & \frac{1}{8} & \frac{1}{16} \\ \frac{1}{8} & \frac{1}{4} & \frac{1}{8} \\ \frac{1}{16} & \frac{1}{8} & \frac{1}{16} \end{bmatrix}$$

25. The method of claim 19, wherein processing each resolution layer further comprises applying a space varying algorithm to minimize a variational problem represented by:

$E(u) = \int_{\Omega} \left( D^2 + \alpha |\nabla D|^2 \right) d\Omega$, subject to $u \in \vartheta$, wherein $\Omega$ is a support of the image, and $D = g*(u-u_o)$, wherein g is a normalized Gaussian kernel with zero mean and small variance $\sigma$, $u_o$ is the input image, u is the output image, and wherein $\alpha$ is a non-negative real number.

26. The method of claim 19, wherein processing each resolution layer comprises applying a space varying algorithm to minimize a variational problem represented by:

$E(u) = \int_{\Omega} \left( \rho_1(D) + \alpha\rho_2(|\nabla D|) \right) d\Omega$, subject to $u \in \vartheta$, wherein $\rho_1$ and $\rho_2$ are scalar functions.

27. The method of claim 26, wherein $\rho_1$ and $\rho_2$ are chosen from the group comprising $\rho(x) = |x|$ and $\rho(x) = \sqrt{1+x^2}$.